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ABSTRACT

This study investigated factors that play a role in the fading effects of prekindergarten programs for economically disadvantaged children. The school adjustment of 1,284 low-income, minority children in prekindergarten and kindergarten programs funded by the government (i.e., Child Parent Center; Head Start) was traced through the third year of school. Data were collected on prekindergarten experience, entering kindergarten cognitive readiness, parental involvement in school activities, assignment to special education, school mobility, grade retention, children's perceptions of academic integration, and cognitive achievement in reading and mathematics. Results of a structural model revealed a network of influences between prekindergarten experience and third-year achievement. The five factors with significant direct effects on third-year achievement, ranked in order of magnitude, were academic integration, entering kindergarten cognitive readiness, retention, parent involvement in school, and school mobility. As expected, retention and mobility had negative effects on achievement. Entering kindergarten cognitive readiness and parent involvement were relatively strong mediators of the effect of prekindergarten on third-year achievement. The mediators of prekindergarten are discussed in regard to enhancing and restricting effects. (Author/RH)

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Sources of Fading Effects of Prekindergarten Experience

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RUNNING HEAD: FADING EFFECTS

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Abstract

This study investigated factors that play a role in fading effects of prekindergarten programs for economically disadvantaged children. The school adjustment of 1284 low-income, minority children in government funded prekindergarten and kindergarten programs were traced through the third year of school. Data were collected on prekindergarten experience (i.e., Child Parent Center or Head Start), entering kindergarten cognitive readiness, parental involvement in school activities, assignment to special education, school mobility, grade retention, childrens' perceptions of academic integration, and cognitive achievement in reading and mathematics. Results of a structural model indicated that entering kindergarten readiness, parent involvement in school, non-retention in grade, and school non-mobility, and academic integration had positive direct effects on achievement. The effects of prekindergarten experience on third-year achievement, however, were indirect, and depended on intervening factors, notably, entering kindergarten readiness, parental involvement, and to lessor degrees grade retention and academic integration. These factors help explain the fading effects of preschool involvement. The mediators of prekindergarten are discussed in regard to enhancing and restricting effects.

Sources of Fading Effects of Prekindergarten Experience

Evaluations of preschool intervention programs for economically disadvantaged students have consistently found that effects on scholastic achievement, while substantial in the short term, fade over time. These results come from a massive research effort of over 400 studies and 52 reviews in the past 20 years (White, 1985-1986). White meta-analyzed 326 of these studies of early intervention programs, most of which included disadvantaged students, and found an average effect size of one-half a standard deviation for the immediate end-of-program, although he noted "over time, there is a clear tendency for the measurable effects of intervention with disadvantaged children to be substantially reduced" (p. 407).

More recently, Haskins (1989) summarized the results of experimental preschool programs and Head Start and concluded that these programs produced significant short-gains in scholastic achievement but that "gains on standardized IQ and achievement tests as well as on tests of socioemotional development decline within a few years" (p. 278). Although both White and Haskins noted that many studies had methodological limitations, particularly those of Head Start, fade out effects of academic achievement do not appear to be an artifact of methodology because they occur for studies employing random assignment to treatment and control groups (Lazar & Darlington, 1982). Nor are fading effects specific to programs for disadvantaged and at-risk children. They have been documented for nearly all programs involving single or isolated experiences (Wachs & Gruen, 1982).[1]

The most obvious question about these results yet one that has been rarely, if ever, investigated is why do intervention effects on scholastic achievement fade with the passage of time? Wachs and Gruen (1982) alluded to this issue in their extensive review of early experience and development by noting the importance of investigating factors that "maximize or minimize the long-term impact of early intervention. It is clear that in most cases an 'inoculation' of enriched early experience will wash out over time unless future conditions are developed to maintain the initial gains. Unfortunately, what must happen to maintain these early gains is not yet clearly understood" (p. 249). Haskins (1989) called for "research on the transition to public schools and other studies designed to account for the fading of intellectual gains achieved in preschool" as well as "the importance of parental involvement...and moderate continuing interventions that could be used to maintain the gains achieved before entry in the public schools" (p. 280).

The issue of fading effects of early interventions, particularly those for disadvantaged children, has been gaining attention as concern about the increasing prevalence of at-risk children in public schools and about their school adjustment has heightened (Pallas, Natriello, & McDill, 1989). Fading effects also denote continuity of development, which is of increasing concern to researchers (McCartney & Jordon, 1990; Scarr, Phillips, & McCartney, 1990).

Some authors have theorized about the nature of these fading effects. Clarke (1984) attributed fading effects of intervention to the greater influence of later experiences, at least one's "total ecology" over time. She cited studies of adopted children who overcame their adverse early environments by

growing up in warm and nurturing environments. Clarke suggested that both families and schools are instrumental in providing continuity in early schooling to maintain effects.

Wachs and Gruen (1982) emphasized the role of the family in maintaining the effects of intervention. They posited that effects will be maintained only to the degree that parents have time and social support to continue intervention, that parents have the motivation and skills, and that the home environment (i.e., crowding, noise) support development. These requirements for effective follow through after interventions are consistent with parental and school efforts suggested by other researchers (Zigler & Valentine, 1979; Bronfenbrenner, 1975).

Empirical research has not directly assessed the issue of maintaining fading effects of prekindergarten (PREK), though important implications have arisen. Becker and Gersten (1982), for example, found positive effects of a direct-instruction program for children in the Follow Through program that helped maintain gains in reading, spelling, and math problem solving in grade 5 and grade 6 relative to children not in direct-instruction programs. Follow-up studies have shown that the effects of PREK are mediated by childrens' schooling including assignment to special education and grade retention (Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984; Lazar & Darlington, 1982; Tietze, 1987), which suggests PREK effects are dependent, to some degree, on later schooling behaviors. As much as these studies document the indirect effects of PREK, the early schooling process was not investigating in any detail, and the generalizibility of their results to government funded programs is unclear (Haskins, 1989).

Other studies have linked lasting effects to teacher expectations and parental ratings of child's ability (Entwisle & Hayduk, 1988), maternal expectations, communication, control strategies, and tonal interaction (Hess, Holloway, Dickson, & Price, 1984). Although these studies are suggestive of reasons for fading effects of early interventions, they did not include intervention variables, did not probe mediating influences, and were not specifically designed for disadvantaged populations.

More directly addressing links that foster and maintain early school success, Reynolds (1989a, 1989b) used structural modeling techniques to investigate the early schooling process of low-income, minority children graduating from government funded kindergarten programs, many of whom attended PREK (i.e., Child Parent Centers [CPC], Head Start). Structural modeling techniques are useful in testing models with intervening variables because of their ability to identify mediating effects of variables. These mediating and indirect effects signify dependencies among variables such as those that may exist between prekindergarten and later achievement. Reynolds (1989a) found that the effects of PREK on first-year reading achievement, math achievement, and socioemotional maturity depended on intervening factors including teacher ratings of parental involvement in school and kindergarten school achievement. Children who attended PREK and whose parents were involved in school did better in school. A second-year follow-up study (Reynolds, 1989b) found that PREK continued to be mediated by parent involvement and kindergarten achievement. Academic motivation and school mobility also contributed to achievement gains but were not directly linked to PREK.

The above studies suggest a few of the variables that may be important in maintaining the effects of preschool or of providing continuity in schooling including motivation, parent involvement, school stability, and early school achievement. The studies, however, were not specifically designed to account for the fading effects of preschool. Reynolds (1989b), for example, examined the time period from kindergarten to second-year; no relation was posited between preschool and entering cognitive readiness. In addition, other factors may need to be considered in explaining fading effects including early school adjustment as measured by grade retention and assignment to special education, school experiences as perceived by children, and intervening achievement; all of which may mediate the effect of PREK positively or negatively.

This study tests a model that specifically investigates mediating factors between enrollment in prekindergarten programs and third-year cognitive achievement. By the third formal year of schooling, the direct effects of preschool on achievement have largely faded (Haskins, 1989; White, 1985-1986), although their indirect effects may remain significant. A primary question is which factors mediate between preschool experience and later achievement?

A Model Addressing Fading Effects

A model to describe fading achievement effects of PREK is shown in Figure 1. This model traces achievement growth from kindergarten entry (ENTER-K to the end of third-year (READ-3 and MATH-3) as a function of school readiness attributes including PREK, sex, and school SES as well as intervening behaviors and events that shape school adjustment and play a role in extending or restricting the effects of PREK. The arrows connecting the variables are the effects to be tested. The thick arrows indicate that ENTER-K and parent involvement are the primary mediators of the effects of PREK on third-year achievement.

In other words, PREK has indirect effects on achievement. An indirect effect is the "extent to which [an] intervening variable accounts for [the] relationship [between a] predetermined and subsequent variable" (Wolfle, 1980, p. 185). Thus, the extent to which PREK is mediated reflects its degree of dependency on intervening factors. These mediators of PREK indicate sources of fading effects (i.e., parent involvement) since they specify how or why effects occur (Baron & Kenny, 1986).

Insert Figure 1 about here

The first intervening factor, entering kindergarten cognitive readiness (ENTER-K) is a powerful mediator of readiness attributes, particularly PREK (Lazar & Darlington, 1982; Berrueta-Clement et al., 1984), and directly influences later school experiences (Butler, Marsh, Sheppard, & Sheppard, 1985). Parental involvement in school is an indictor of concern and interest in childrens' education is expected to have a major role in PREK effects (Wachs & Gruen, 1982; Clarke, 1984). Such effects have been accumulating for children in CPC programs (Chicago Public Schools, 1987a; Conrad & Eash, 1983; Reynolds, 1989a), but have not been directly tested as a factor in fading effects. The effect of PREK on

third-year achievement, for example, may be dependent on or transmitted through parent involvement in school such that children participating in PREK and whose parents are involved in school activities are more likely to do better in school.

Factors culminating by third-year, assignment to special education, school mobility (the number of times children change schools between kindergarten and third-year, and grade retention (whether a child was retained-in-grade between kindergarten and third-year) represent life events that may exacerbate discontinuity in early schooling. Thus, they may lower cognitive performance and reduce the long-term effects of PREK. Children, for example, who are retained-in-grade during early schooling are likely to experience difficulties that may neutralize the effects of PREK (Jackson, 1975; Slavin & Madden, 1989). Also, children experiencing environmental disruption as a result of changing schools are less likely to experience continuity in their academic development (Reynolds, 1989b).

Academic integration, the final intervening factor between PREK and third-year achievement, is the self-evaluation of childrens' school behavior and adjustment. Such perceptions are generally recognized as a salient component of school adaptation (Harter, 1983; Phillips, 1987). Consequently, perceptions of academic integration may help meditate the effects of PREK as well as relate to achievement.

The model is conceptually similar to previous specifications (Reynolds, 1989a, 1989b). The sequencing of variables is based on time precedence. Readiness attributes, the characteristics children bring with them to school, precede other factors conceptually and temporally. Similarly, entering kindergarten cognitive readiness has a recursive influence on other endogenous variables. Parental involvement, measured in first-year, precedes other intervening factors, since it was measured in first-year, and may be a relatively powerful influence on childrens' achievement behavior.[2] The remaining variables, assignment to special education, mobility, retention, and academic integration were measured in third-year, well after prior factors. Although academic integration could be a consequence of achievement as much as a predictor of achievement, the purpose of the study was to examine fading achievement effects.

Three results were expected. (1) The primary effect of prekindergarten on third-year achievement would depend on entering kindergarten cognitive readiness. (2) The effect of prekindergarten on third-year achievement would be enhanced by parent involvement in school activities. (3) The effect of prekindergarten would be reduced by assignment to special education, grade retention, and school mobility.

Data

Data come from the Longitudinal Study of Children at Risk (LSCAR), a prospective study tracing the school adjustment of a panel of 1300 low-income, minority children graduating in 1986 from Educational Consolidation and Improvement Act (ECIA) Chapter 1 and Chapter 2 kindergarten programs. Because they are minority, come from low-income neighborhoods, and receive lunch subsidies, these children are at risk of experiencing school difficulties (Pallas et al., 1989).

Children participated in one of four programs: Chapter 1 CPC, Chapter 2 CPC, Chapter 2 Home-School, and Head Start (Effective Schools Project). These programs were designed to improve cognitive readiness skills for the primary grades. The CPCs and Head Start are intensive and comprehensive interventions that enroll economically disadvantaged children beginning in preschool, require parental involvement, and provided extra school staff for program implementation. The Home-School program enrolled children in kindergarten, did not require parent involvement, and was open to any child in the school district.

The childrens' longitudinal record included information on attendance in prekindergarten (i.e., CPC or Head Start), sex, school socioeconomic status, entering kindergarten cognitive readiness, grade placement, assignment to special education, parental involvement in school as assessed by teachers, student self-evaluations of school adjustment ("I am smart", "I do my homework", "I answer questions in class"), and achievement in reading and mathematics at the end of their third year of school. These data were collected from 1985 (kindergarten) to 1989 (third-year or third-grade for most children). Descriptive statistics of 1284 children are shown in Table 1 (see Appendix A for full description of variables).[3] A majority of children (69%) participated in preschool (Head Start or CPC) and came from predominantly low-income areas. Seven percent of the sample was assigned to special education in third-year, 15% were retained in grade between kindergarten and third-year, and 44% changed schools at least once between kindergarten and third-year (only the mean number of moves, .6, is listed). Parent involvement in school was relatively low (rated 2.7 on a five-point scale), and childrens' level of academic integration was relatively high. Regarding cognitive performance, the children as a group began at roughly the average school readiness level (0 years, 1 month), although by third-year they were approximately 5 months behind the achievement of the average third-grade child in reading comprehension ($\underline{M}$ = 3.3) and mathematics total ($\underline{M}$ = 3.5).[4]

Insert Table 1 about here

Correlations among the variables are given in Table 2. They were computed using latent-variable techniques (LISREL 7, Joreskog & Sorbom, 1988), resulting in the most precise estimates of linear association.[5] Third-year achievement was measured by reading comprehension and mathematics total scores. The pattern of correlations indicate that the measures tap separate but related aspects of schooling. The PREK-achievement correlation declined substantially from kindergarten entry to the end of third-year ($\underline{r}$ = .267 to .090), suggesting fading effects that have been consistently noted in the literature. Also notable is the moderate correlation between cognitive readiness and third-year achievement ($\underline{r}$ = .451), suggesting the predictive power of entering school readiness on achievement nearly four years later. The negative correlations of school mobility ($\underline{r}$ = -.266) and grade retention ($\underline{r}$ = -.475) with third-year achievement are indicative of their disruptive effects in school adjustment. On

the other hand, two other intervening variables, parent involvement ($\underline{r}$ = .365) and academic integration ($\underline{r}$ = .489) had moderate positive achievement associations.

Insert Table 2 about here

Results

The results of the structural model are shown in Figure 2 (see Appendix B for a complete specification). This model fit the observed data well[6] and was superior to alternative specifications.[7] As shown, there is a network of influences between prekindergarten and third-year achievement. Five factors had significant direct effects on third-year achievement including in order of magnitude: academic integration, entering kindergarten cognitive readiness, retention, parent involvement in school, and school mobility. As expected, retention and mobility had negative effects on achievement.

The major result of the model, however, was that ENTER-K and parent involvement, as expected, were relatively strong mediators of the effect of PREK on third-year achievement. Thus, the effect of PREK appears to be explained by and dependent on these intervening factors, at least partially. In the remainder of this section, these mediating influences are described.[8]

Insert Figure 2 about here

Mediators of PREK

As noted earlier, the indirect effect of PREK on third-year achievement is a measure of its dependence on intervening factors in exerting lasting effects. The standardized indirect effect of PREK was .226 which is equivalent to approximately two months performance on achievement. In other words, the effect of PREK is mediated significantly by other factors. It is notable that its indirect effect is not substantially lower than its immediate effect on achievement ($\underline{b}$ = .300). The five major paths through which PREK is mediated is shown in Figure 3.

Insert Figure 3 about here

Not surprisingly, entering cognitive readiness is the largest source of PREK's indirect effect (Path A), representing over 30% of its aggregate indirect effect ($\underline{b}$ = .087). Therefore, much of the effect of PREK on later achievement depends on entering school readiness, the extent to which it influence later achievement.

The other sources of indirect effects are at least one-half the size of the PREK-ENTER-K-ACHIEV-3 link, but are notable. Path B indicates that parental involvement is important in maintaining the effects of PREK, at least as measured by teachers' assessment of school involvement. Children

participating in PREK and whose parents are involved in school activities are likely to benefit more from PREK than children whose parents are not so involved.

A third dependency through which PREK influences later achievement is ENTER-K and retention (Path C). This path indicates that children who are retained between kindergarten and third-year are likely to experience lower achievement, thereby reducing the effect of PREK over time. The same is true of the parent involvement-retention-ACHIEV-3 relation (Path D), in that, retention disrupts the chain of influences through which PREK influences achievement. Both of these results are not surprising, since a child who is retained has experienced a discontinuity in early schooling that PREK cannot inoculate them from. Although greater entering kindergarten achievement reduces the probability of retention, it cannot completely offset negative retention effects. Path E, which includes perceived academic integration, indicates that childrens' perceptions of their school work and ability is a strong source of PREK's influence on achievement. PREK is more likely to maintain achievement effects if it is paired with higher entering achievement and more positive self-evaluations from children.

Growth by Kindergarten Program

Figures 2 and 3 indicate that children in PREK, having higher entering kindergarten achievement, higher parent involvement, and lower mobility and grade retention are likely to maintain cognitive gains over time including gains attributable to PREK. Table 3 provides summary data on cognitive performance and associated adjustment factors by childrens' kindergarten program. These data document the differential adjustment of children. The results confirm, in large part, the structural analysis. Children in CPC programs, most of whom had PREK, entered kindergarten at a greater level of cognitive readiness than children with less PREK (i.e., in non-CPC programs). Also notable is the stability of cognitive growth of children from the Chapter 2 CPC program. At the end of third-year they are performing at grade level in both reading comprehension ($\underline{M}$ = 3.8) and mathematics total ($\underline{M}$ = 3.9), well above the other groups, including their Chapter 1 counterparts who began kindergarten at the same level of cognitive readiness.

Insert Table 3 about here

Why did Chapter 2 CPC children maintain their level of cognitive performance over time when other children did not? Apart from possible differences in kindergarten program quality, Chapter 2 CPC children as a group changed schools less frequently, were retained in grade less often, and were rated higher in parent involvement than children in other programs.[9] In fact, the group with the highest mobility and retention rates also had the slowest achievement growth from kindergarten to third-year. These differences in mobility, retention and parent involvement are all plausible, since they were significantly related to achievement growth over and above that of other factors (see Figure 2).

Discussion

This study investigated factors through which prekindergarten experience influenced achievement four years later in order to identify sources of its fading effects. Results indicated that the effects of PREK are more likely to be passed on to year 3 achievement if children enter kindergarten at higher levels of readiness, parents are involved in activities with their child's school, and if children are not retained-in-grade between kindergarten and third-grade. These factors appear to be links in early schooling that help maintain stability in academic performance.

Kindergarten cognitive readiness is the greatest source through which the effect of PREK is transmitted to later achievement. Consequently, the effect of PREK is dependent on the level of childrens' school readiness. Although prekindergarten experience makes a significant contribution to success in kindergarten, the primary factor remains cognitive readiness. It appears to be the driving force behind childrens' early school success. PREK increases but does not fully compensate for ENTER-K's role as a primary early influence on school success. This result, however, is to be expected. PREK is a single, short-term intervention in the lives of children; cognitive readiness is an enduring attribute of individuals.

The importance of cognitive readiness in kindergarten is consistent with previous studies (Butler et al., 1985; Carter, 1984; Gersten, Becker, Heiry, & White, 1984; Reynolds, 1989a). The mediating role of kindergarten cognitive readiness suggests that efforts to maintain early gains over time and improve the school success of at-risk children must focus on enabling children to begin school at relatively high levels of readiness. For this to occur, additional experiences prior to school entry may be required including day-care (Burchinal, Lee, and Ramey, 1989) and early home stimulation (Bradley and others, 1989).

Parent involvement in school, at least as rated by teachers, is a mediator between PREK and year 3 achievement that appears to transmit an advantage to children. The effect of PREK is more likely to be passed on to achievement if parents are involved in their children's education. Higher parent involvement was a distinction of Chapter 2 CPC children that may have helped them maintain early gains while other children did not. Thus, parents who take a more active role in their child's education may be at least partially, an effective replacement to PREK intervention provided it is constant for an extended period of time (Bronfenbrenner, 1975; Wachs & Gruen, 1982). The mediating role of parent involvement is consistent with previous findings (Stevenson & Baker, 1987; Reynolds, 1989a, 1989b), though additional research is needed to determine the specific behaviors and attitudes that may elicit its effect.

Of course, it is possible that teachers may have assigned behaviors other than just parent involvement (classroom performance, maturity) to their ratings in which case the effects of parent involvement would be overestimated. However, the simultaneous estimation of effects certainly reduced this problem. Even if confounding effects were not totally eliminated, teacher assessment of parent involvement (and maturity or competence) is an important source of carrying forward the effects of

PREK to later achievement. This interpretation corroborates Entwisle & Hayduk's (1988) findings on the effects of teacher assessments on maintaining effects from primary to elementary school.

Three additional factors were also notable. Two of them, retention and academic integration, appear to mediate the effects of PREK. Retention disrupts the early schooling process (Jackson, 1975), which in this study appears to reduce the likelihood of stability of PREK effects. This is not surprising, since a child who is positively influenced by PREK yet enters kindergarten at a relatively low readiness level is at greater risk of being retained in early schooling, in which case the effect of PREK may be neutralized. On the other hand, children who integrate themselves in the early schooling process, perceiving themselves capable of academic work, appear more likely to maintain effects. This may constitute a form of resilience necessary for continuity in early schooling.

The third factor, school mobility, was not a major mediator of PREK but was a disruptive cumulative influence on year 3 achievement. This is consistent with previous findings (Reynolds, 1989b). Unfortunately, this result suggests low-income, minority children do not recover from the effects of mobility during the first three years of schooling. Discontinuity or environmental disruption appears to be a major stumbling block for children at risk.

Prekindergarten Experience Reconsidered

The fading effects of PREK on later achievement should not be taken to suggest that PREK is not important after its immediate effect wares off. On the contrary, and as present results indicate, PREK has substantial indirect effects on the early schooling process. With few exceptions, these effects have not been fully considered in the research and policy literature (Reynolds, 1989b). Moreover, since entering kindergarten readiness is a pervasive influence in early schooling, the contribution of PREK is all the more important. PREK's total contribution to achievement behavior (ENTER-K + ACHIEV-3) is equivalent to four to five months or one-half a standard deviation. Thus, the effects of PREK may not fade as much as they are incorporated into intervening variables.

Continuity and Discontinuity in Early Schooling

The fading effects of preschool on academic achievement and the stability of achievement are dependent on a number of links in which many factors contribute including cognitive readiness, parent involvement, grade promotion, school stability, and academic integration. Unfortunately, these links never exist simultaneously for all children, especially children at risk of school problems. The interplay of these factors and others (i.e., home environment, curriculum continuity) may be responsible for fading effects of PREK as well as drops in performance over time. On the other hand, because the early schooling process is a network of inter-related effects, altering one factor necessarily changes, to some degree, the entire system of effects. While this inter-relatedness impels educators to design programs and interventions with multiple effects, it also suggests that fostering continuity in early schooling is not beyond the reach of families and schools.

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Footnotes

[1]Evidence is accumulating on the long-term effects of preschool in nonachievement areas including assignment to special education, retention, graduation rates (Berrueta-Clement et al., 1984; Haskins, 1989). It should be cautioned, however, that these results are not based on studies of government funded programs. Also, it is not clear the extent to which some of these findings take advantage of statistical chance in testing multiple outcomes.

[2]Preliminary analysis indicated its effects on achievement were relatively constant over time. Placing parental involvement later in the schooling process did not change the interpretation of the results.

[3]The analyzed sample was reached by first deleting cases missing on any of the following: kindergarten program, third-year achievement test scores, and more than two waves of achievement data from first- to third-year. Any missing data on children remaining were plugged with the mean of their kindergarten program group. There were two exceptions. Missing responses on indicators of academic integration were plugged with sample means, since there were no differences among groups. Children missing one within time achievement subtest score (reading or math) were plugged with their score on the nonmissing subtest.

[4]These test scores may be overestimated since they are based on 1977-1978 norms. A comparison of third-grade norm group scores between 1977-1978 and 1984 suggests the overestimation may be as high as three months in reading comprehension and two months in mathematics total (Hieronymus & Hoover, 1986).

[5]Inter-factor correlations are based on the measurement model. These results were obtained by first estimating a polychoric correlation matrix of measured variables, which adjusts variables for their ordinal properties and provides the best estimate of linear association (Joreskog & Sorbom, 1988). Next, to adjust for measurement error reliabilites of the measured variables were, if known, entered in the program (in diagonal of Theta Delta matrix). These included, from the normative sample, ENTER-K (Rel. = .94), READ-3 (Rel. = .91), and MATH-3 (Rel. = .94). If not known, they were estimated, based on knowledge of how the data was collected and on likely coding errors. Estimates were as follows: PREK (Rel. = .80), sex (Rel. = 1.00), school SES (Rel. = .80), special education, mobility, and retention (Rel. = .95), and parent involvement (Rel. = .80). Reliabilities of measures of academic integration were estimated by LISREL, since multiple measures of it were available. Estimates ranged for .116 to .549 and are interpreted as the minimum reliability provided the model is correct (Joreskog & Sorbom, 1988). Finally, because many of the measures came from similar methods correlations among measurement errors were estimated among measures of academic integration and between third-year reading and mathematics achievement.

[6]Assessment of model fit was based on multiple criteria including the ratio of chi-square to the degrees of freedom, the adjusted goodness of fit index (AGFI, Joreskog & Sorbom, 1988a), and the root mean squre residual (RMR), the average difference between the observed correlations and values estimated by the model as well as the intrepretability of the parameter estimates. Substantively interpretive models with chi-square ratios below three (Carmines & McIver, 1981), an AGFI above .9 (Cuttance, 1987), and an RMR below .05 were judged as good-fitting. The model satisfied these criteria: $X^2(\underline{91}, \underline{N} = 1284) = 245.25$, chi-square ratio = 2.70, AGFI = .964, RMR = .032.

[7]Nonsignificant paths ($\underline{T} < 2.00$) were deleted from the model which were theoretically defensible. Structural coefficients were stable from model to model. Three across-equation correlations (unmeasured common causes) were also estimated (assignment to special education and retention, mobility and retention, and prekindergarten experience and year 3 achievement).

[8]Due to a substantial amount of missing data, parent education was not reported as a primary variable. Responses from 500 parents indicted that 59% graduated from high school. Adding parent education to the analysis using pairwise-present cases revealed few changes in the results. Most notably, parent education was unrelated to PREK ($\underline{r} = .023$) and did not add to the explanation of achievement growth between kindergarten and third-year.

[9]Because entry into preschool and kindergarten programs is voluntary, self-selection is an alternative explanation to the higher performance of Chapter 2 CPC children over time. Two findings disconfirmed this hypothesis. First, there was a negligible correlation between PREK and parental education, and PREK and school SES, suggesting family and demographic statuses were unrelated to preschool enrollment and its effects over time. Also, a separate analysis found no evidence of an unmeasured common cause between PREK and year 3 achievement (e.g., parent motivation, school selectivity), which would be expected in the presence of self-selection.

Table 1

Descriptive statistics of variables

Variable	Mean	Std Dev	Minimum	Maximum	Brief description
PREK	.69	.46	0	1	Prekindergarten experience (1 = PREK)
Sex	.51	.50	0	1	Child's sex (1 = girls)
School SES	33.22	9.49	13.70	55.20	Percent of non-low-income families
ENTER-K	.12	.42	-.70	2.10	Entering Kind. cognitive read.
Parent Inv.	2.65	1.16	1	5	parents partic. in school
Special Ed.	.07	.26	.00	1.00	Referral to special education (1 = Sp. Ed)
School mobility	.58	.76	.00	3.00	Number of school moves
Retention	.15	.36	.00	1.00	Ever retained in grade (1 = retained)
Acad. Integ.	16.55	2.36	5.00	21.00	Academic Integration (7-item composite)
READ-3	3.32	1.17	.4	7.2	Year 3 ITBS GE reading achiev.
MATH-3	3.53	.95	.2	6.2	Year 3 ITBS GE mathematics achiev.

Note. N = 1254. SES = socioeconomic status; READ-3 = year 3 reading achievement; MATH-3 = year 3 math achievement; ITBS = Iowa Tests of Basic Skills; GE = grade-equivalents.

Table 2

Correlations among factors of early schooling

	PREK	Sex	School SES	ENTER-K	Parent Inv.	Special Ed.	Mobility	Retent.	Acad. Integ.	Year 3 Achiev.
PREK	1.000									
Sex	.046	1.000								
School SES	.022	-.040	1.000							
ENTER-K	.250	.059	-.077	1.000						
Parent Inv.	.293	.123	.025	.206	1.000					
Special Ed.	-.135	-.070	-.025	-.085	-.079	1.000				
Mobility	-.020	-.035	-.015	-.151	-.210	.013	1.000			
Retention	-.124	-.140	.014	-.293	-.201	.192	.190	1.000		
Acad. Integ.	.126	.119	.065	.272	.211	-.113	-.146	-.212	1.000	
Year 3 Achiev.	.090	.140	.104	.151	.365	-.167	-.266	-.475	.489	1.000

Note. Coefficients computed from LISREL 7 measurement model (Joreskog & Sorbom, 1988a). They are based on polychoric correlations and are adjusted for measurement error and correlations among measurement errors. PREK = prekindegarten experience; SES = socioeconomic status; ENTER-K = entering kindergarten cognitive readiness; Parent Inv = parent involvement; Special Ed = special education; Retent = retention; Acad. Integ. = academic integration; Year 3 Achiev = reading comprehension and mathematics.

Table 3

Child background and measures of school adjustment by kindergarten program

Program	Sample Size	Number of Schools	Percent in PREK	Mean Parent Inv.	Percent in Sp. Ed.	Percent with 1 or more moves	Percent Retained by year 3	Mean Acad. Integ.	Cognitive achievement (GE)		
									Enter. K	Year 3	Gain
									Reading/ Math		
Chapter 1 Child-Parent Center	562	14	94%	2.8	5%	51%	12%	16.9	0.2	3.3	3.1
									0.2	3.6	3.4
Chapter 2 Child-Parent Center	229	6	90%	3.2	6%	32%	5%	17.4	0.2	3.8	3.6
									0.2	3.9	3.7
Chapter 2 Home-School	164	6	31%	2.2	12%	38%	24%	16.8	-0.2	3.3	3.1
									-0.2	3.5	3.3
Effective Schools Project	329	6	39%	2.3	9%	43%	24%	16.5	0.1	3.0	2.9
									0.1	3.2	3.1
Total	1284	26	69%	2.7	7%	44%	15%	16.8	0.1	3.3	3.2
									0.1	3.5	3.4

Note. GE = grade-equivalents. Chapter 2 Child-Parent Center and Chapter 2 Home-School children attended the same kindergarten schools. PREK = prekindergarten; Enter. K = entering kindergarten composite cognitive readiness; Parent Inv. = parent involvement (5-point scale); Sp. Ed. = special education; Acad. Integ. = academic integration (7-item composite from 7 to 21).

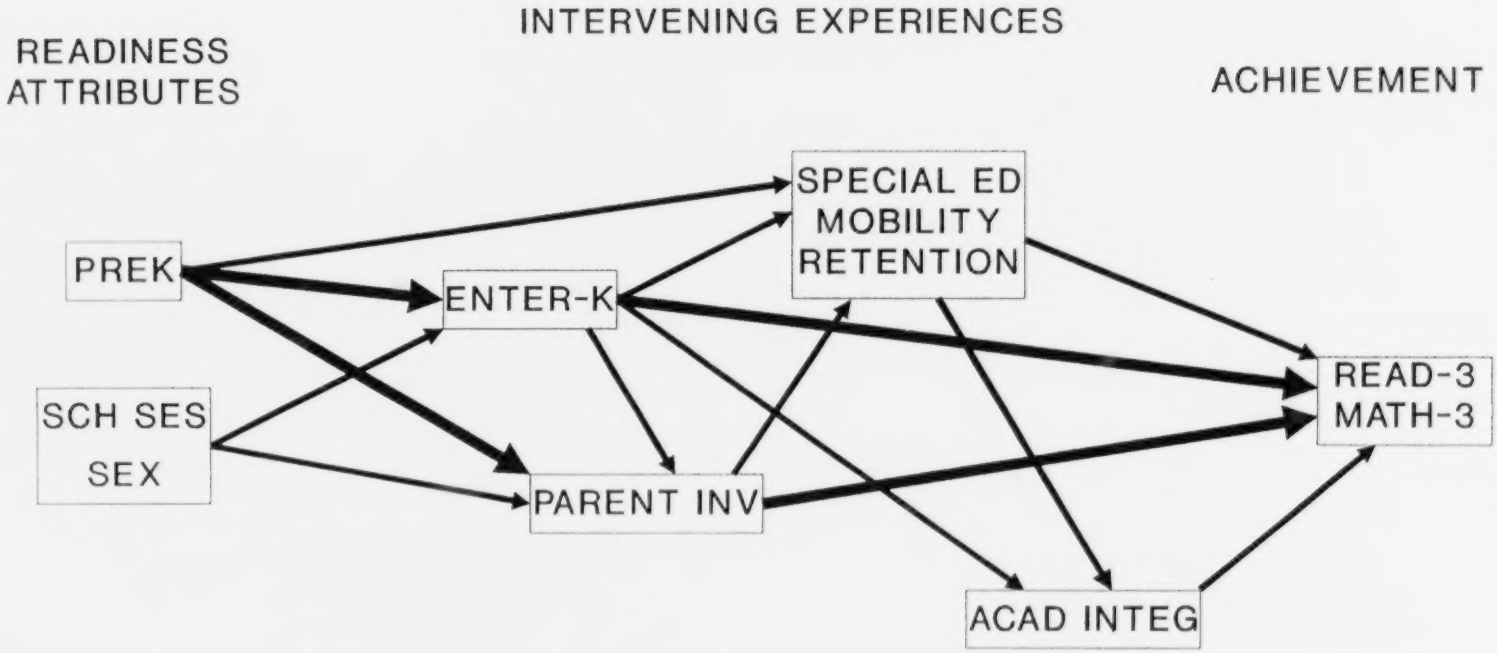

Figure 1. A model for the mediation of prekindergarten (see text for variable definitions)

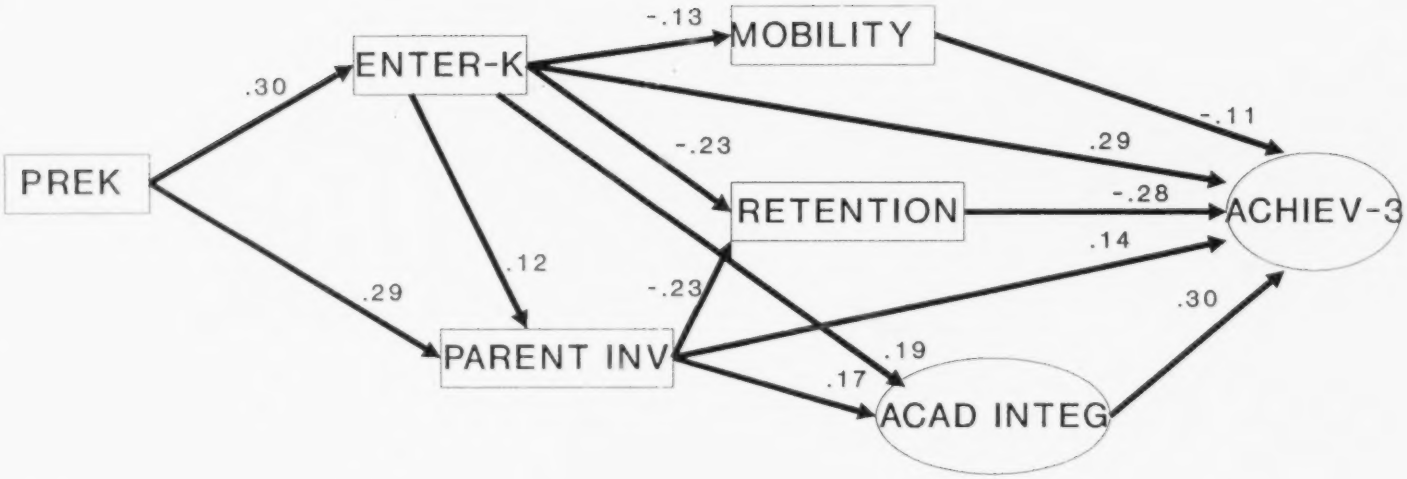

Figure 2. Notable factors mediating the effects of PREK
(Effects are standardized coefficients; Ellipses
are latent factors; see text for variable definitions)

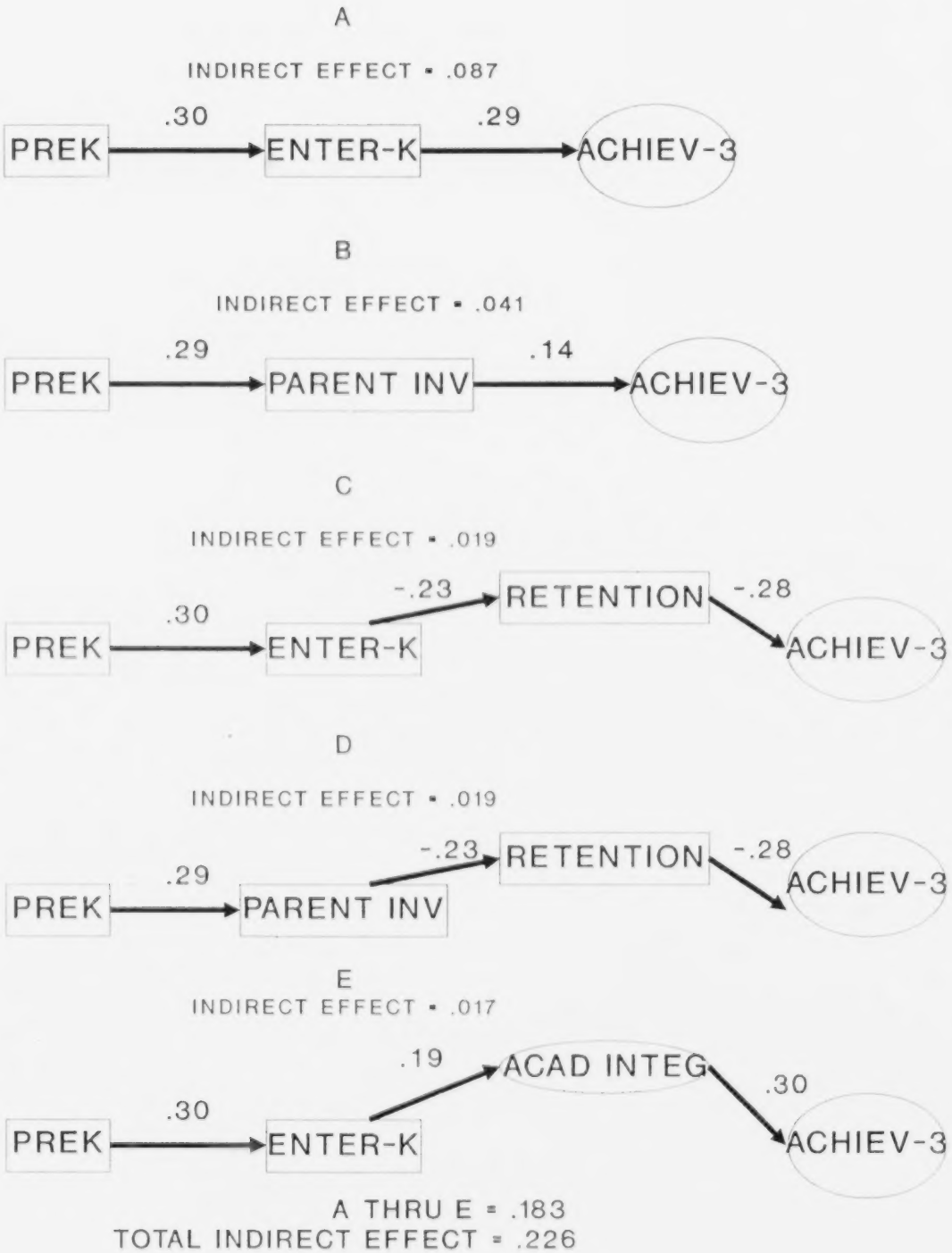

Figure 3. The five greatest PREK dependencies

Appendix A: Description of Variables

Prekindergarten experience (PREK). Students who had no Chicago public school prekindergarten experience were coded 0. Those with any experience (e.g., Head Start or Child Parent Center) were coded 1. This information was obtained directly from computerized student records. Prekindergarten status was affirmed if students were documented as being enrolled in prekindergarten from fall 1983 to spring 1985.

School Socioeconomic Status (school SES). This socioeconomic context variable was defined as 100 - the percent of low-income families within a school's geographical area (Chicago Public Schools, 1987b). Not to be confused with family background or socioeconomic status, it is a broad indicator of the socioeconomic context in which children have lived and attended school. School SES was collected during kindergarten and applies to a child's kindergarten school area. Values ranged from 40 to 80% and confirmed the diverse context in which children lived at kindergarten entry.

Sex. Sex was coded 0 for boys and 1 for girls.

Entering Kindergarten Cognitive Readiness (ENTER-K). Comprehensive grade equivalent (GE) scores on the fall 1985 Iowa Tests of Basic Skills (ITBS) (Level 5 Form 7) were used as a measure of entering school readiness (Hieronymus, Lindquist, & Hoover, 1980a). The test measures a broad array of readiness skills including listening, word analysis, vocabulary, language, and mathematics. Reported internal consistency reliability is .94. This coefficient reflects the large number of items in the test, but is impressive given the age of children tested.

Parent involvement in school (parent involvement). Toward the end of first-year, teachers assessed the amount of parent involvement in school activities on a single item "parent's participation in school". Responses ranged from poor, not at all (1) to excellent, much (5). Construct distinction was confirmed through principal components analysis of the first-year assessment. Although teacher reports may not be completely representative of parent involvement in school, the focus on general school relations is clearly an area which a teacher would be expected to know. The analysis allowed for some unreliability in its measurement.

Assignment to special education (Special Ed). Children on record as being in special education classes during the 1988-1989 school year (third-year) were coded 1, all others 0. Categories included emotionally mentally handicapped, language minority.

School mobility (mobility). This measure was defined as the number of times a child changed schools between kindergarten and third-year. Values ranged from 0 to 3. Students leaving the school system were not tracked.

Grade retention (retention). Children on record as not being in third-grade or higher during the 1988-1989 school year were coded 1, all others 0.

Academic Integration. In the spring of 1989 (third-year), children responded to a 42-item survey about their school adjustment and experiences at home. Seven trichotomously coded items (i.e., a lot, sometimes, not much) were supported by the first factor in principal components analysis with varimax rotation and in confirmatory factor analysis. These included "I get good grades in school", "I am smart", "I get in trouble at school", "I try hard in school", "I do my homework", "I give up when school work gets hard", and "I answer questions in class".

Third-year reading and mathematics achievement (READ-3 and MATH-3). Spring 1989 Iowa Tests of Basic Skills (ITBS) reading comprehension and math total grade-equivalent subtest scores (Level 8 or 9 Form 7) measured cognitive achievement (Hieronymus et al., 1980b). The reading comprehension subtest includes 44 multiple-choice items (Level 8 has 67 items) on recognizing facts, making inferences, and developing generalizations from textual material. The mathematics total subtest contains 90 multiple choice items (Level 8 has 88 items) divided into concepts, problems, and computation. Both have high internal consistency reliabilities (READ-3, Rel. = .91; MATH-3, Rel. = .94), and converged on a single dimension in confirmatory factor anaiysis.

Appendix B

Standardized maximum likelihood estimates for final model (Figure 2)

	ENTER-K	Parent Inv	Special Ed	Mobility	Retention	Self-image	Year 3 Achiev
PREK	.300	.287	-.115	-	-	-	-
Sex	-	-	-	-	-.100	.091	-
School SES	-.095	.219	-	-	-	-	.079
ENTER-K	-	.118	-	-.128	-.230	.192	.291
Parent Inv	-	-	-.092	-.117	-.232	.171	.141
Special Ed	-.116	-	-	-	-	-	-.055
Mobility	-	-	-	-	-	-.071	-.112
Retention	-	-	-	-	-	-.076	-.280
Acad. Integ.	-	-	-	-	-	-	.303
R^2	.096	.163	.029	.036	.136	.123	.470

X^2 = 245.25(91, N = 1284, chi-square ratio = 2.70)

Note. PREK = prekindergarten experience; ENTER-K = entering kindergarten cognitive readiness; Parent Inv = parent involvement; Special Ed = special education; SES = socioeconomic status. Acad. Integ. = academic integration. Dashes indicate effects was not estimated. Estimates are adjusted for errors-in-variables and errors in equations.